1.) (a) correct end points (A1)(A1)

max = 27, min = 4

range = 23 A1 N33

(b) Graph 3 A2 N22

[5]

2.) (a) $\Sigma fx = 1(2) + 2(4) + ... + 7(4)$, $\Sigma fx = 146 + 5x$ (seen anywhere) A1

evidence of substituting into mean = $\frac{\sum fx}{\sum f}$ (M1)

correct equation A1

e.g. $\frac{146+5x}{34+x} = 4.5$, $146 + 5x = 4.5(34 + x)$

$x = 14$ A1N2

(b) $\sigma = 1.54$ A2N2

[6]

3.) (a) (i) evidence of appropriate approach (M1)

e.g. 9 + 25 + 35, 34 + 35

$p = 69$ A1 N2

(ii) evidence of valid approach (M1)

e.g. 109 – their value of p, 120 – (9 + 25 + 35 + 11)

$q = 40$ A1N2

(b) evidence of appropriate approach (M1)

e.g. substituting into $\frac{\sum fx}{n}$, division by 120

mean = 3.16 A1N2

(c) 1.09 A1N1

[7]

4.) (a) $\sigma = 1.61$ A2 N2

(b) median = 4.5 A1N1

(c) $Q_1 = 3$, $Q_3 = 5$ (may be seen in a box plot) (A1)(A1)

IQR = 2 (accept any notation that suggests the interval 3 to 5) A1N3

[6]

5.) (a) evidence of using mid-interval values (5, 15, 25, 35, 50, 67.5, 87.5) (M1)

$\sigma = 19.8$ (cm) A2 N3

(b) (i) $Q_1 = 15$, $Q_3 = 40$(A1)(A1)

$IQR = 25$ (accept any notation that suggests the interval 15 to 40) A1 N3

(ii) **METHOD 1**

60 % have a length less than k (A1)
$0.6 \times 200 = 120$ (A1)
k 30 (cm) A1N2

METHOD 2

$0.4 \times 200 = 80$ (A1)
$200 - 80 = 120$ (A1)
$k = 30$ (cm) A1N2

(c) $l < 20$ cm $\Rightarrow$ 70 fish (M1)

P(small) = $\frac{70}{200}$ (= 0.35) A1N2

(d)

Cost \$$X$	4	10	12
P($X = x$)	**0.35**	0.565	**0.085**

A1A1N2

(e) correct substitution (of their p values) into formula for E(X) (A1)
e.g. $4 \times 0.35 + 10 \times 0.565 + 12 \times 0.085$

E(X) = 8.07 (accept \$8.07) A1N2

[15]

6.) (a) 18 A1 N1

(b) (i) 10 A2 N2

(ii) 44 A2N2

[5]

7.) (a) evidence of using $\sum f_i = 100$ (M1)

$k = 4$ A1 N2

(b) (i) evidence of median position (M1)

e.g. 50^{th} item, 26 + 10 + 20 = 56

median = 3 A1 N2

(ii) Q_1 = and $Q_3 = 5$ (A1)(A1)

interquartile range = 4 (accept 1 to 5 or 5−1, *etc*.) A1 N3

[7]

8.) (a) (i) $p = 65$ A1 N1

(ii) for evidence of using sum is 125 (or $99 - p$) (M1)

$q = 34$ A1 N2

(b) evidence of median position (M1)

e.g. 63^{rd} student, $\frac{125}{2}$

median is 17 (sit-ups) A1 N2

(c) evidence of substituting into $\frac{\sum f(x)}{125}$ (M1)

e.g. $\frac{15(11)+16(21)+17(33)+18(34)+19(18)+20(8)}{125}, \frac{2176}{125}$

mean = 17.4 A1 N2

[7]

9.) (a) median $m = 32$ A1 N1

(b) lower quartile $Q_1 = 22$, upper quartile $Q_3 = 40$ (A1)(A1)
interquartile range = 18 A1 N3

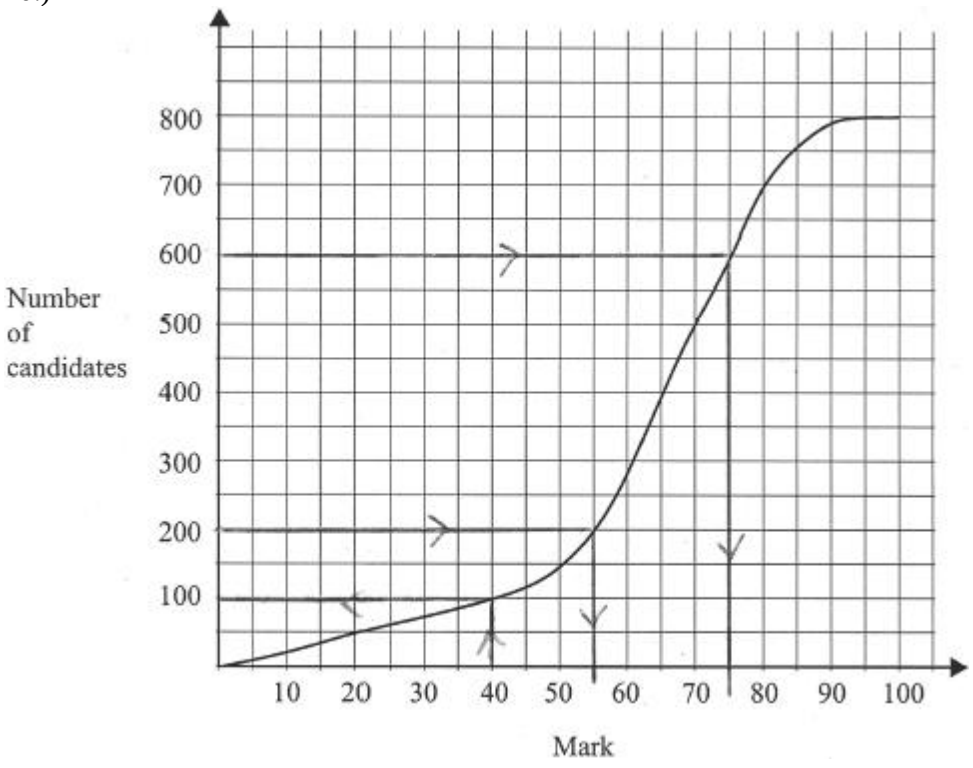
(c)

Time (minutes)	Number of students
$0 \le t < 10$	5
$10 \le t < 20$	**11**
$20 \le t < 30$	20
$30 \le t < 40$	24
$40 \le t < 50$	**14**
$50 \le t < 60$	6

A1A1 N2

[6]

10.)



(a) Lines on graph (M1)
100 students score 40 marks or fewer. A1N2

(b) Identifying 200 **and** 600 A1
Lines on graph (M1)
$a = 55$, $b = 75$ A1A1N1N1

[6]

11.) (a) (i) $m = 165$ A1 N1

(ii) Lower quartile (1^{st} quarter) = 160 (A1)

Upper quartile (3^{rd} quarter) = 170 (A1)

IQR = 10 A1 N3

(b) Recognize the need to use the 40^{th} percentile, or 48^{th} student (M1)

eg a horizontal line through (0, 48)

$a = 163$ A1 N2

[6]

12.) (a) A = 18, B = 19, C = 23, D = 31, E = 36 A1A1A1A1A1 N5

(b) IQR = 12 A1 N1

[6]

13.) (a) Correct mid interval values 14, 23, 32, 41, 50 (A1)

Substituting into $\frac{\sum f w}{\sum f}$ M1

eg $\overline{w} = \frac{7(14)+12(23)+13(32)+10(41)+8(50)}{50}$

$\overline{w} = \frac{1600}{50}$ A1

$\overline{w} = 32$ (kg) AG N0

(b) **METHOD 1**

Total weight of other boxes = $1600 - 50x$ (A1)

Total number of other boxes = $50 - x$ (A1)

Setting up **their** equation M1

eg $\frac{1600-50x}{50-x} = 30$, $1600 - 50x = 1500 - 30x$

$x = 5$ A1 N3

METHOD 2

Let z be the number of other boxes in Class E (accept any symbol in the working, even including x).

Total weight of other boxes = $1200 + 50z$ (A1)

Total number of other boxes = $42 + z$ (A1)

Setting up **their** equation M1

eg $\frac{1200-50z}{42+z}$ = 30, 1200 + 50*z* = 1260 + 30*z*

z = 3

x = 5 A1 N3

(c) Setting up their inequality M1

Correct substitution A1

eg $\frac{98+276+416+41(10+y)+400}{50+y} < 33$, $\frac{1600-41y}{50+y} < 33$

1600 + 41*y* < 1650 + 33*y* (A1)

8*y* < 50 (*y* < 6.25) A1

6 A1 N1

Note: *If candidates don't use the mid-interval values, but assume that all the new boxes weigh the minimum amount for Class D, award marks as follows:*

Setting up **their** inequality M1

Correct substitution A1

eg $\frac{1600-36.5y}{50+y} < 33$

1600 + 36.5*y* < 1650 + 33*y* (A1)

3.5*y* < 50 (*y* < 14.28...) A1

14 A1 N1

[12]

14.) (a)

Age range	Frequency	Mid - interval value
0 ≤ age < 20	40	10
20 ≤ age < 40	**70**	**30**
40 ≤ age < 60	**100**	**50**
60 ≤ age < 80	**50**	**70**
80 ≤ age ≤ 100	**10**	**90**

A1A1 N2

(b) For attempting to find $\sum f x$ (M1)

Correct substitution (A1)

eg 40 × 10 + ... + 10 × 90 = 11900

For dividing by 270 (M1)

eg $\frac{11900}{270}$

Mean = 44.1 A1 N4

[6]

15.) $b = 3, c = 3$ A1A1 N2

using mean $\left(\frac{a+b+c+d}{4}=4\right)$ M1

using range ($d - a = 6$) M1

$a = 2, d = 8$ A1A1 N2

[6]

16.) (a) (i) $r = 10$ A2 N2

(ii) $s = 13$ A2 N2

(b) Using $\frac{\sum x}{12}=10$ A1

$t = 18$ A1 N1

[6]

17.) (a) D B C A1A1A1 N3

(b) B A C A1A1A1 N3

[6]

18.) (a) 3 A1 N1

(b) 6 A2 N2

(c) Recognizing the link between 6 and the upper quartile (M1)

eg 25% scored greater than 6,

0.25×32 (A1)

8 A1 N3

[6]

19.) (a) (i) 50 (accept 49, "fewer than 50") A1 N1

(ii) Cumulative frequency (7) = 90 (A1)

$90 - 50$ (M1)

$= 40$ A1 N2

(iii) 75th or 75.5th person A1

median = 6.25 (min), 6 min 15 secs A1 N1

(b) Evidence of finding 40% (60%) of 150 M1

Number spending less than k minutes is $(150 - 60) = 90$ (A1)

$k = 7$ A1 N2

(c) (i)

t (minutes)	$0 \le t < 2$	$2 \le t < 4$	$4 \le t < 6$	$6 \le t < 8$	$8 \le t < 10$	$10 \le t < 12$
Frequency	10	23	**37**	**38**	**27**	15

A1A1A1 N3

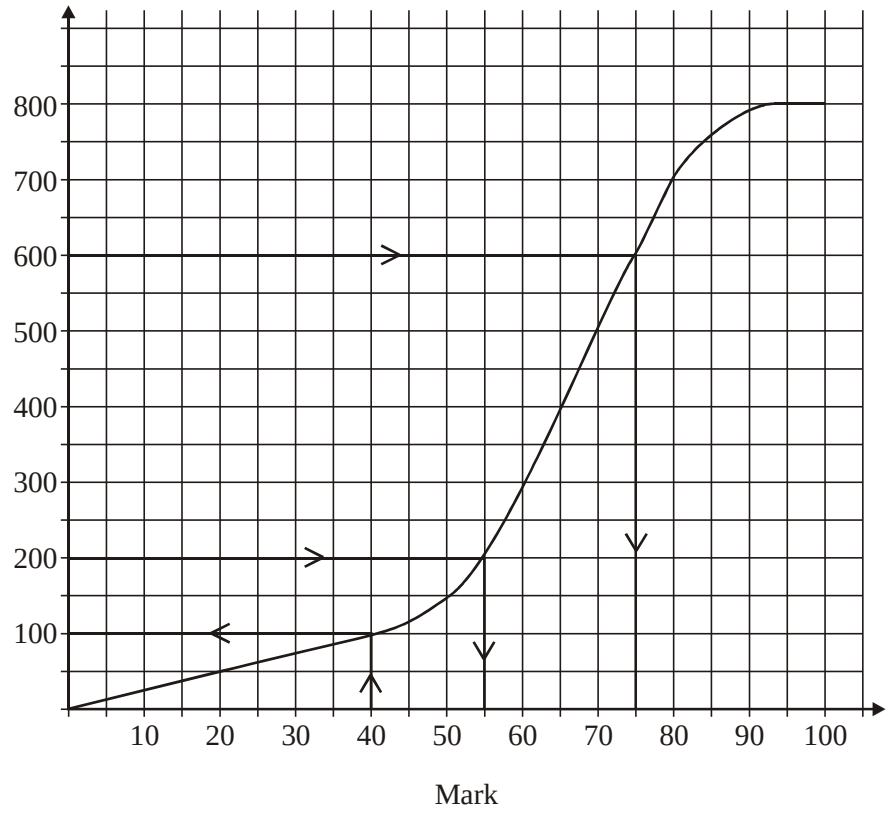
(ii) Evidence of using **all** correct mid-interval values (1, 3, 5, 7, 9, 11) A1

$$\text{mean} = \left(\frac{1\times10+3\times23+5\times37+7\times38+9\times27+11\times15}{150}\right)$$

= 6.25 (min), 6 min 15 secs A1 N1

[14]

20.)



(a) Lines on graph (M1)
100 students score 40 marks or fewer. A1 2

(b) Identifying 200 and 600 A1
Lines on graph. (M1)
$a = 55$, $b = 75$. A1A1 4

[6]

21.) (a) $\text{mean} = \sum \frac{x}{n} \left(= \frac{2230}{45}\right)$ (M1)

$\bar{x} = 49.6$ (Accept 50) (A1) (C2)

(b) $\bar{y} = \frac{\sum y}{n+2}$ (may be implied) (M1)

$\sum y = 2230 + 37 + 30$ (A1)

$\bar{y} = \frac{2297}{47}$ (A1)

$= 48.9$ (Accept 49) (A1) (C4)

[6]

22.) (a) Mean $= \frac{\sum f x}{\sum f}$

$\sum f x$ = (1) (0) + (2) (4) + (3) (6) + (4) (k) + (5) (8) + (6) (6) + (7) (6) (A1)

$\sum f \quad k + 30$ (A1)

Using mean $4.6 = \frac{144 + 4k}{k + 30}$ (M1)

$4.6k + 138 = 144 + 4k$ (A1)

$0.6k = 6$

$k = 10$ (A1)(C5)

(b) Mode = 4 (A1) (C1)

(accept 5, if $k < 8$)

[6]

23.) (a) 76 (mice) (A1) (N1)

(b) 11.2 (seconds) (A1) (N1)

(c) (i) $p = 76 - (16 + 22) = 38$(allow **ft** from (ii) (a)) (A1) (N1)

$q = 132 - 76 = 56$ (A1) (N1)

(ii) $x = \frac{7.5 \times 16 + ...14.5 \times 23}{16 + ...23} \quad \left(= \frac{3363}{300}\right)$ (M1)

$= 11.2$ (accept 11.21) (A1) (N2)

[6]

24.) (a)

Mark (x)	$0 \le x < 20$	$20 \le x < 40$	$40 \le x < 60$	$60 \le x < 80$	$80 \le x < 100$
Number of Students	22	**50**(±1)	**66**(±1)	**42**(±1)	20

(A1)(A1)(A1) (C3)

(b) 40th Percentile $\Rightarrow$ 80th student fails, (mark 42%) (M2)
Pass mark 43% (Accept mark > 42.) (A1) (C3)

[6]

25.) List of frequencies with p in the middle

eg 5 + 10, p, 6 + 2 $\Rightarrow$ 15, 8, or $15 < \frac{23+p}{2}$, or $p > 7$. (M1)

Consideration that $p < 10$ because 2 is the mode or discretionary for further processing. (M1)

Possible values of p are 8 and 9 (A2)(A2) (C6)

[6]

26.) (a) line(s) on graph (M1)
median is 183 (A1) (C2)

(b) Lower quartile $Q_1 = 175$ (A1)

Upper quartile $Q_3 = 189$ (A1)

IQR is 14
(Accept 189 – 175, 175 to 189, 189 to 175 and 175 – 189) (M1)(A1) (C4)

[6]

27.) $d = 11$; $c = 11$ (A1)(A1) (C1)(C1)

$d - a = 8$ (or $11 - a = 8$) (A1)
$a = 3$ (A1) (C2)

$\frac{3+b+11+11}{4} = 8$ $\left(\text{or } \frac{\text{sum}}{4} = 8\right)$ (A1)

$b = 7$ (A1) (C2)

[6]

28.)

x	f	Σf
4	2	2
5	5	7
6	4	11
7	3	14
8	4	18
10	2	20
12	1	21

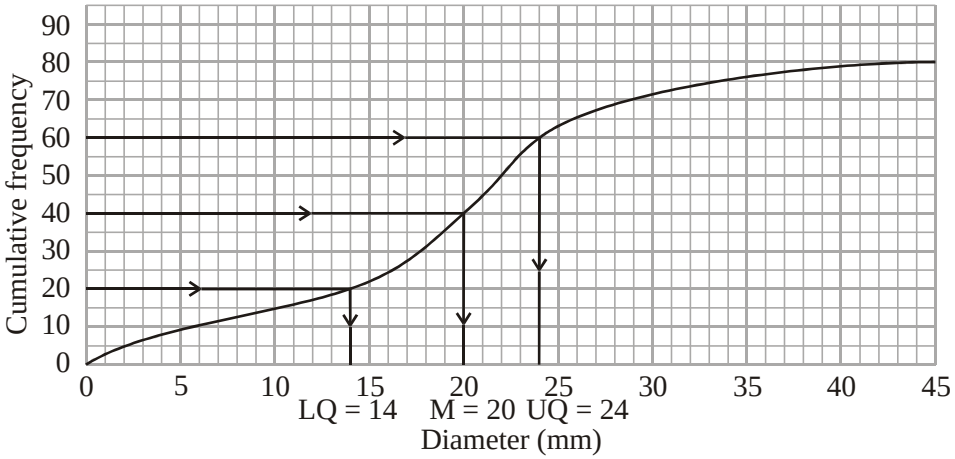
(a) m = 6 (A2) (C2)

(b) $Q_1 = 5$ (A2) (C2)

(c) $Q_3 = 8$ (A1)
IQR = 8 – 5 (M1)
= 3 (accept 5 – 8 or [5, 8]) (C2)

[6]

29.)



(a) (i) Correct lines drawn on graph,(A1)(C1)
median = 20 (A1)(C1)

(ii) Correct lines drawn on graph, (A1)(C1)
UQ = Q_3 = 24 (A1)(C1)

(b) IQR = $Q_3 - Q_1$(or UQ – LQ) (M1)
= 10 (accept 14 to 24) (A1) (C2)

Note: *Accept 14 to 24, 24 to 14, 14 – 24 or 24 –14.*

[6]

30.) Jan–Sept $\sum = 630 \times 9 = 5670$ (M1)(A1)
Oct–Dec $\sum = 810 \times 3 = 2430$ (M1)(A1)

$$\bar{x} = \frac{5670 + 2430}{12}$$ (M1)

mean = 675 (A1) (C6)

[6]

31.) (a) (i) median fare = \$24 (±0.5) (A1)

(ii) fare ≤ \$35 => number of cabs is 154 (or 153) (A1) 2

(b) 40% of cabs = 80 cabs (A1)
fares up to \$22 (A1)
distance = \$22 ÷ \$0.55 (M1)
a = 40 km (A1) 4

(c) Distance 90 km => fare = 90 × \$0.55
= \$49.50 (A1)

Fare \$49.50 => number of cabs = 200 –186 (M1)
= 14 (A1)

Thus percentage is $\frac{14}{200}$ = 7% (A1) 4

[10]

32.) Median = middle value => $b = 11$ (A1)

Mean = $\frac{a+b+c}{3} = \frac{a+11+c}{3}$ = 9 => $a + 11 + c = 27$ (M1)

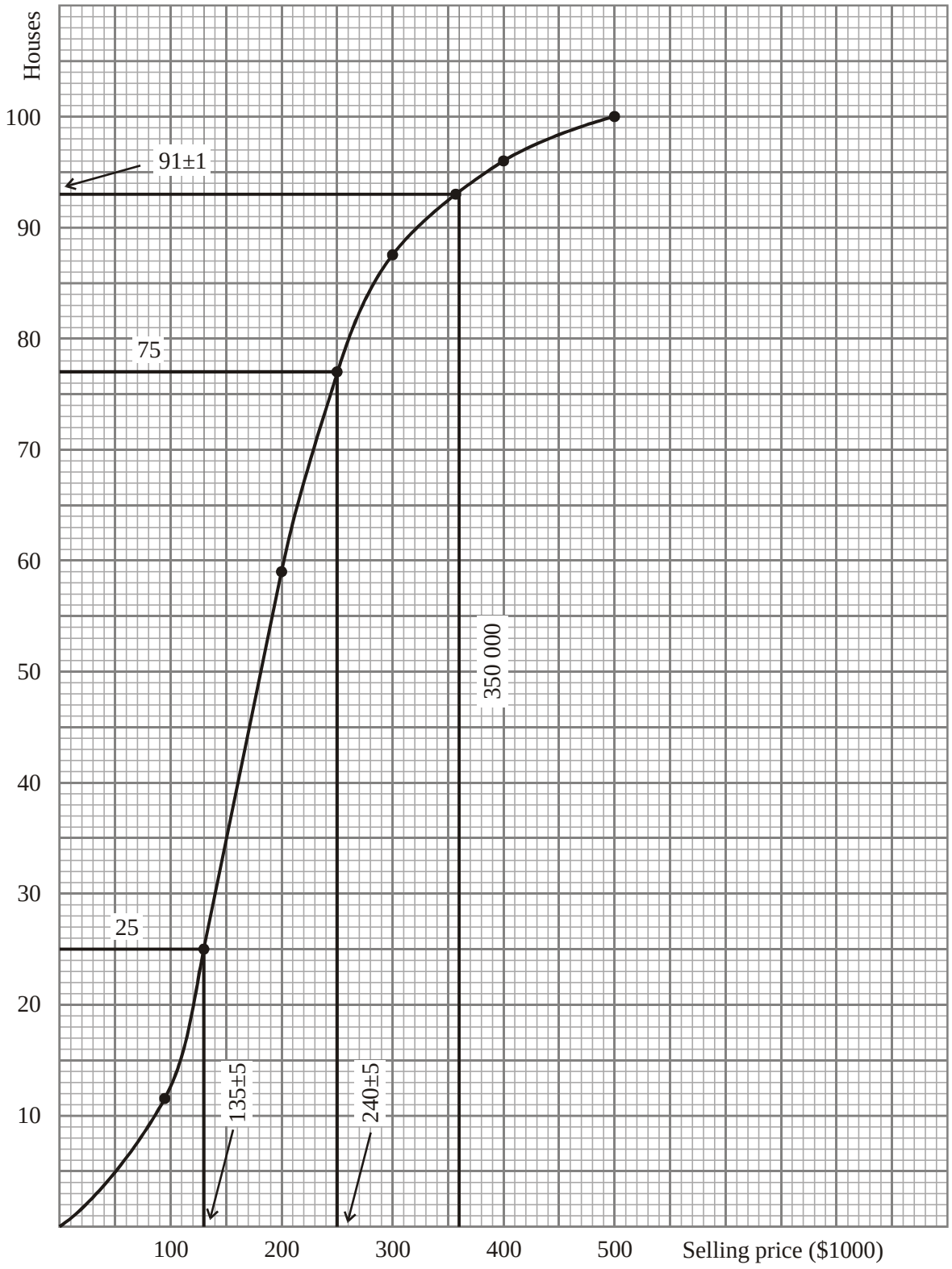
=> $a + c = 16$ (A1)

Range = $c – a = 10$ (M1)(A1)

Solving equations simultaneously gives $a = 3$ (A1) (C6)

[6]

33.) (a)



(A1)(A2)(A1) 4

Notes: *Award (A1) for correct axes, scales and labelling, (A1) for correctly plotted points.*
Award (A2) for good curve correctly drawn, (A1) for badly drawn, correct curve.
Award (A1) for a correct polygon.

(b) $Q_1 = 135 \pm 5$ $Q_3 = 240 \pm 5$ (M1)(A1)
Interquartile range $= 105 \pm 10$. (Accept 135 – 240 or 240 – 135.) (A1) 3

Note: *Award (M1) for the correct lines on the graph.*

(c) $a = 94 - 87 = 7,\ b = 100 - 94 = 6$ (A1)(A1) 2

(d) mean $= \dfrac{12(50)+46(150)+29(250)+7(350)+6(450)}{100}$ (M1)

$= 199$ or \$199000 (A1)

OR

mean = 199 or \$199000 (G2) 2

(e) (i) \$350000 => 91.5

Number of *De luxe* houses $\simeq 100 - 91.5$ (M1)

$= 9$ or 8 (A1)

(ii) P (both > 400000) $= \dfrac{6}{9}\left(\dfrac{5}{8}\right) = \dfrac{5}{12}$ or $\dfrac{6}{8}\left(\dfrac{5}{7}\right) = \dfrac{15}{28}$ (M1)(A1) 4

Note: *Award (M1)(A0) for the answers* $\dfrac{4}{9}$ or $\dfrac{9}{16}$ *obtained from correct independent probabilities.*

[15]

34.) (a) Median = middle number of 75 (M1)

= 38th number

= 4 (A1) (C2)

(b) Mean $= \dfrac{5+18+48+72+100+42}{75}$ (M1)

$= \dfrac{285}{75}$

= 3.8 (A1) (C2)

[4]

35.) (a) $s = 7.41$(3 sf) (G3) 3

(b)

Weight (W)	$W \le 85$	$W \le 90$	$W \le 95$	$W \le 100$	$W \le 105$	$W \le 110$	$W \le 115$
Number of packets	5	15	**30**	**56**	**69**	**76**	80

(A1) 1

(c) (i) From the graph, the median is approximately 96.8.

Answer: 97 (nearest gram). (A2)

(ii) From the graph, the upper or third quartile is approximately 101.2.

Answer: 101 (nearest gram). (A2) 4

(d) Sum = 0, since the sum of the deviations from the mean is zero. (A2)

OR

$\sum (W_i - \overline{W}) = \sum W_i - \left(80\dfrac{\sum W_i}{80}\right) = 0$ (M1)(A1) 2

(e) Let A be the event: $W > 100$, and B the event: $85 < W \le 110$

$P(A \mid B) = \dfrac{P(A \cap B)}{P(B)}$ (M1)

$P(A \cap B) = \frac{20}{80}$ (A1)

$P(B) = \frac{71}{80}$ (A1)

$P(A \mid B) = 0.282$ (A1)

OR

71 packets with weight $85 < W \leq 110$. (M1)

Of these, 20 packets have weight $W > 100$. (M1)

Required probability $= \frac{20}{71}$ (A1)

$= 0.282$ (A1) 4

Notes: *Award (A2) for a correct final answer with no reasoning.*
*Award up to (M2**)** for correct reasoning or method.*

[14]

36.) (a) (Using mid-intervals)

$\bar{v} = \frac{65(7) + 75(25) + ... + 135(5)}{7 + 25 + ... + 5}$ (M1)

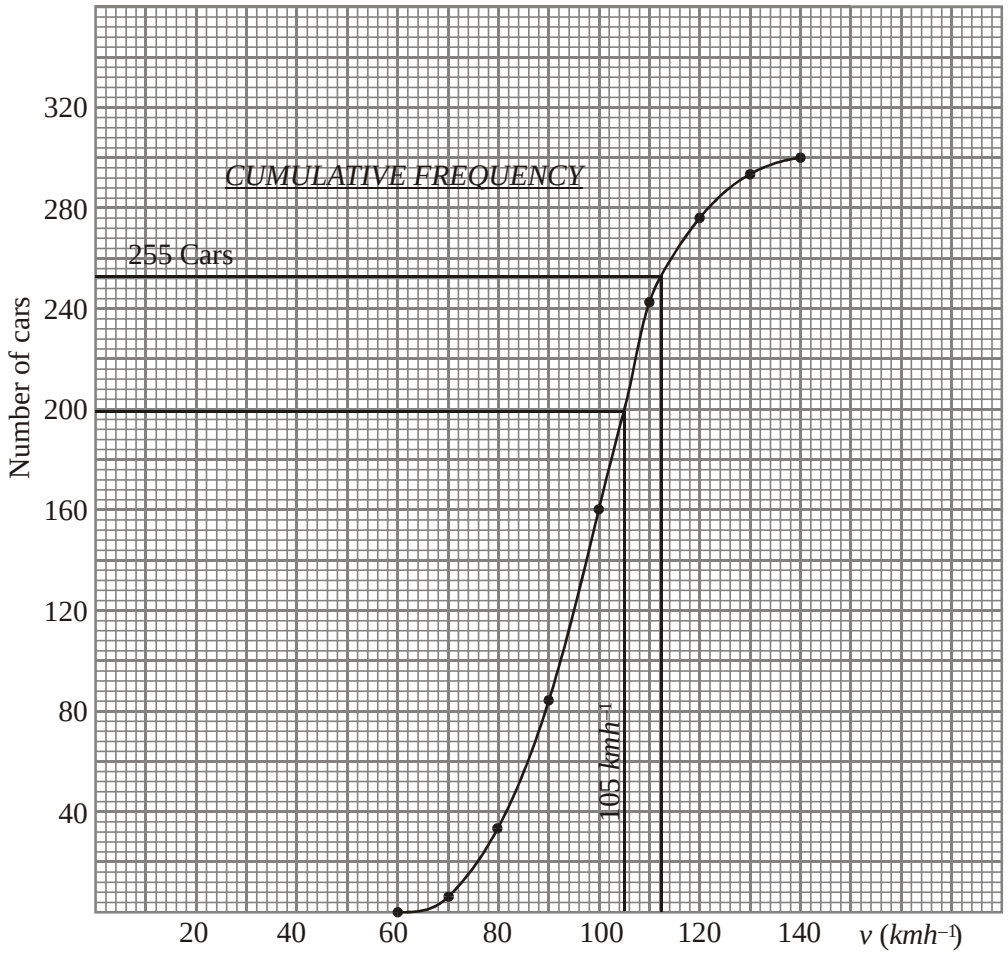
$= \frac{29450}{300} = 98.2 \text{ km h}^{-1}$ (A1)

OR

$\bar{v} = 98.2$ (G2) 2

(b) (i) $a = 165$, $b = 275$ (A1)

(ii)



(A4) 5

Note: *Award (A1) for properly marked scales and axes, (A2) for 9 correctly plotted points, (A1) for 7 or 8 points, (A1) for a smooth curve through the points.*

(c) (i) Vertical line on graph at 105 km h^{-1} (M1)

$\frac{300 - 200}{300} \times 100\% = 33.3(\pm 1.3\%)$ (A1)

OR

33.3(±1.3%) (A2)

(ii) 15% of 300 = 45 300 – 45 = 255

Horizontal line on graph at 255 cars (M1)

Speed = 114(± 2 km h^{-1}) (A1)

OR

Speed = 114(± 2 km h^{-1}) (A2) 4

[11]

37.) (a) (i) 10 (A1)

(ii) 14 + 10 = 24 (A1) 2

(b)

	x_i	f_i
(A1)	15	1
	25	5
	35	7
	45	9
	55	10
	65	16
	75	14
	85	10
	95	8
		80 (AG)

(A1)

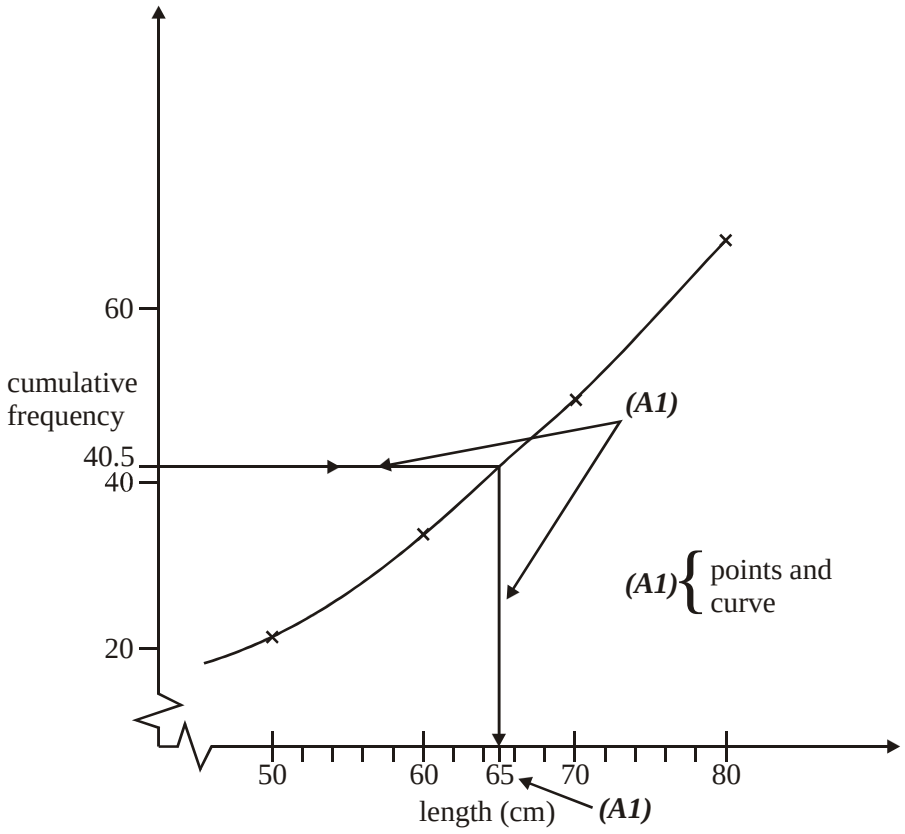
Note: *Award (A0) for using the mid-interval values of 14.5, 24.5 etc.*

(i) m = 63 (A1)

(ii) s = 20.5 (3 sf) (A1) 4

(c) Assymetric diagram/distribution (A1) 1

(d)



3

OR Median = 65 (A3) 3

Note: *This answer assumes appropriate use of a calculator with correct arguments.*

OR Linear interpolation on the table: (M1)

$$\left(\frac{48-40.5}{48-32}\right)\times 60+\left(\frac{40.5-32}{48-32}\right)\times 70 = 65 \text{ (2sf)}$$ (A1)(A1) 3

[10]

38.) (a) $\bar{x}$ = \$59 (G2)

OR

$$\bar{x}=\frac{10\times 24+30\times 16+...+110\times 10+130\times 4}{24+16+...+10+4}$$ (M1)

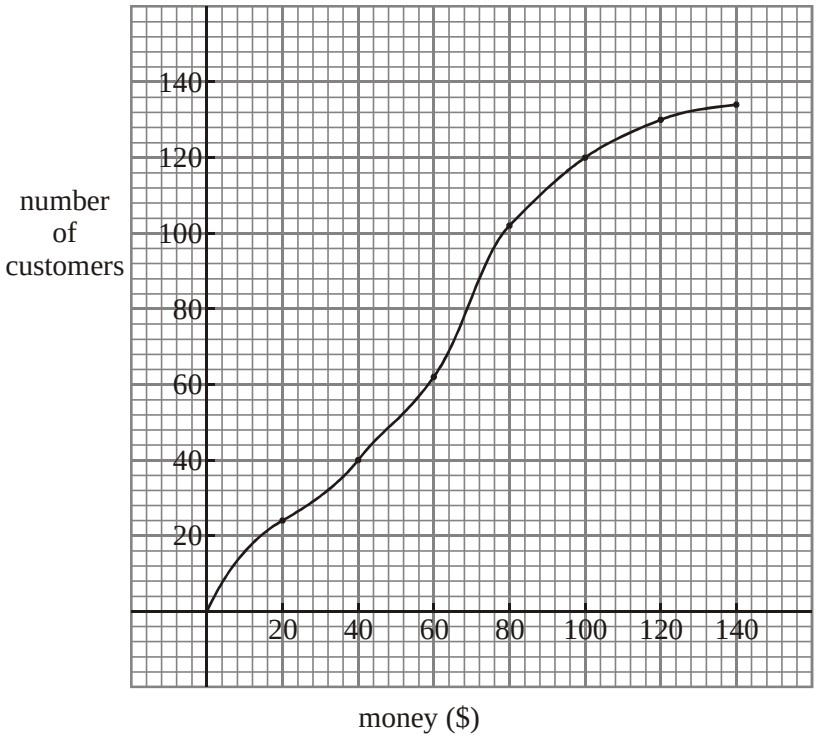
$$= \frac{7860}{134}$$

= \$59 (A1) 2

(b)

Money (\$)	<20	<40	<60	<80	<100	<120	<140
Customers	24	40	**62**	**102**	**120**	**130**	**134**

(A1)



(A4) 5

Note: *Award (A1) for the correct scale, (A1) for the points, and (A2) for the curve.*

(c) (i) $t = 2d^{2/3} + 3$

Mean d = 59 (M1)

Mean $t \approx 2 \times (59)^{2/3} + 3$ (M1)

$\approx$ 33.3 min. (3 sf) (accept 33.2) (A1)

(ii) $t > 37 \Rightarrow 2d^{2/3} + 3 > 37$ (M1)

$2d^{2/3} > 34$

$d^{2/3} > 17$ (A1)

$d > (17)^{3/2}$

$d > 70.1$

From the graph, when d = 70.1, n = 82 (A1)

number of shoppers = 134 – **82** (A1)

= **52** (A1) 8

[15]

39.) $\dfrac{(10\times1)+(20\times2)+(30\times5)+(40\times k)+(50\times3)}{k+11} = 34$ (M1)(A1)

$\dfrac{40k+350}{k+11} = 34$(A1)

$\Rightarrow k = 4$ (A1) (C4)

[4]

40.) (a)

x	15	45	75	105	135	165	195	225
f	5	15	33	21	11	7	5	3

(M1)

$\bar{x}$ = 97.2 (exactly) (A1) 2

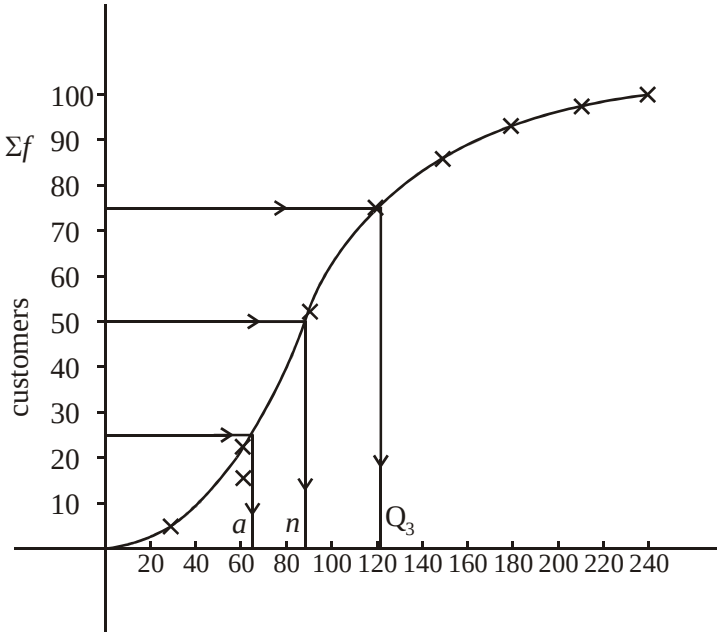
(b)

x	30	60	90	120	150	180	210	240
Σf	5	20	53	74	85	92	97	100

(A1) 1

Note: *Award (A1) for correct values for x, ǵf.*

(c)



(A4) 4

Notes: *Award (A2) for 6 or more points correct, (A1) for 4/5 points correct.*
Award (A1) for a reasonable graph, (A1) for the correct axes and the given scales.

(d) Median = 87 ± 2 (A1)

Lower quartile = 65 ± 2 (A1)

Upper quartile = 123 ± 2 (A1) 3

[10]

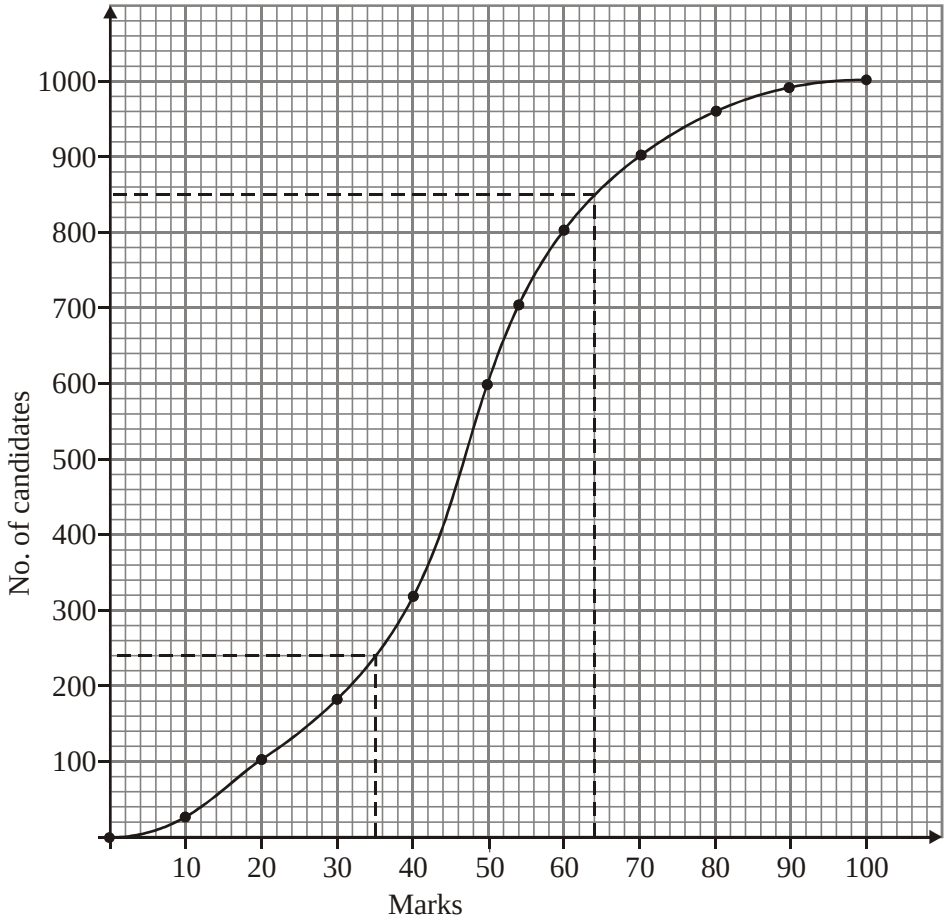
41.) (a)

Mark	≤ 10	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60	≤ 70	≤ 80	≤ 90	≤ 100
No. of Candidates	15	65	**165**	335	595	815	905	950	980	**1000**

(A3) 3

Note: *Award (A1) for 165, (A1) for 1000, (A1) if all other entries are correct.*

(b)



(A5) 5

Notes: *Vertical axis and scale* *(A1)*
Horizontal axis and scale *(A1)*
Points *(A1)*
Curve (allow polygon) *(A2)*

(c) (i) Median = 46(M1)(A1)

(ii) Scores < 35: 240 candidates (M1)(A2)

(iii) Top 15% ⇒ Mark ≥ 63 (M1)(A1)(A1) 8

Notes: *Accept the answers from the* ***student's*** *graph.*
In each part, award (M1) for the dotted lines on the graph.

[16]

42.) Mean = $\frac{(72 \times 1.79) + (28 \times 1.62)}{100}$ (M1)(M1)(M1)

= 1.7424 (= 1.74 to 3 sf) (A1) (C4)

[4]

43.) (a) $m = \frac{300}{25}$ (M1)

= 12 (A1) (C2)

(b) $s = \sqrt{\left(\frac{625}{25}\right)}$ (M1)

= 5 (A1) (C2)

[4]